Pacific Herring Stocks and Fisheries in the Arctic-Yukon-Kuskokwim Region of the Bering Sea, Alaska, 2000

A Report to the Alaska Board of Fisheries

Compiled by

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INTRODUCTION

The objectives of this report are to summarize the results of the 2000 Pacific herring stock assessment programs for the Arctic-Yukon-Kuskokwim (AYK) Region, review 2000 management strategies and harvests in all AYK commercial and subsistence herring fisheries, and present harvest projections and general management strategies for the 2001 fishing season. Commercial fishing districts included in this report consist of the Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence Districts (Figures 1 and 2).

The Alaska Board of Fisheries established threshold biomass levels, below which commercial harvests are not allowed under the Bering Sea Herring Fishery Management Plan (5 AAC 27.060, ADF&G 1999), for all districts with the exception of the Port Clarence District. Exploitation rates are limited to a maximum of 20% in all areas. In some areas, the Board of Fisheries has further restricted exploitation rates to protect subsistence harvests. All AYK herring districts open and close by emergency order authority. The Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries were designated limited entry status in 1987. A moratorium to new entry was placed on the Goodnews Bay herring fishery starting in 1998. In Norton Sound two new fisheries were allowed beginning in 1998, open pound spawn on kelp and spawn on wild *Fucus* kelp. In addition, all AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

In March 2000 the Alaska Board of Fisheries approved a provision to allow cooperative purse seine commercial fishing for herring in the Nunivak Island District. The provision was approved with a sunset clause that will terminate the fishery after this year unless renewed by the Board.

A total biomass of 59,134 tons of herring was estimated to have been present in the surveyed portion of the AYK Region herring districts in 2000 (Tables 2 and 5, Figure 3). The 2000 return was 16% below the 5-year average (1995-1999) of 70,716 tons. Young herring (ages 5 or less) averaged approximately 18% of the biomass in the region. Middle-aged herring (ages 6-8) comprised almost one-third of the biomass in all districts combined. Older herring (ages 9 and older) constituted approximately one-half of the biomass in the region. Ages 7 and 9 were the dominant age groups in nearly all the Kuskokwim herring districts (Security Cove, Goodnews Bay, Nelson Island and Nunivak Island). Ages 4 and 7 dominated the herring biomass in the Cape Avinof District. Ages 7 and 12 were the dominant age groups in the Cape Romanzof and Norton Sound Districts. The average age among all herring districts was 7.3 years. Cape Avinof had the youngest average age (5.5 years) while Cape Romanzof had the oldest average age (8.2 years). Overall, the recruitment percentage in number of fish was 35%, an increase from 1999, primarily due to increased numbers of age 4 herring returning in all districts. DuBois (*in press*) presents information on sampling effort and age composition in 2000.

In recent years, some processors in western Alaska herring fisheries have adjusted delivery weights of the landed catch to reflect water weight. Newly implemented dewatering equipment

used by some tenders has resulted in lower harvest weights on fish tickets compared to recent years. Beginning in the 1999 season, the Alaska Department of Fish and Game, Division of Commercial Fisheries issued a newly designed fish ticket that includes a check box where tender boat operators can record the type of weight used. The 'dry' weights recorded on some fish tickets in 2000 were converted to a 'wet' weight to maintain consistency in harvest reporting and estimated exploitation rate.

The 2000 herring harvest for the AYK Region was approximately 6,531 tons, a decrease from the 1999 harvest of 7,630 tons (Table 1 and Figure 4). The 2000 harvest is 29% below the 5-year average (1995-1999) of 9,248 tons. Food and bait sales during the sac roe fishery totaled 262 tons and 17 tons of waste was reported, with the remaining harvest sold as sac roe product (Table 2). Harvest identified as food and bait primarily occurs during the sac roe fisheries when fish are sold with a roe content that is below buyer's acceptable minimums. In some years, wastage occurs when fishermen abandon gillnets or cannot sell their catch. This amount is added to the total harvest and is included in calculations of exploitation rates. The 2000 total exploitation rate for the AYK Region was 11.0%. Exploitation rates ranged from 0.3% in the Goodnews Bay District to 17.3% in the Nelson Island District (Table 2).

An awareness among processors, managers and fishermen of poor market conditions and the need for a high-quality product has helped produce high roe percentages in recent years. Roe recoveries in the sac roe harvest ranged from 9.1% in the Cape Romanzof District to 10.7% in the Security Cove District, with a combined regional roe recovery of 9.5% (Table 2).

The 2000 estimated ex-vessel value for the AYK Region of $1,269,000 was a decrease compared to the 1999 value of $1,996,000 (Table 2). The 2000 value is 30% of the 5-year average (1995-1999) of $4,184,000, and approximately 15% of the record value of $8,730,000 in 1996. There was a lower value in 2000 because of a decrease in harvest and average price paid. In 2000, the average price paid to fishermen for herring with 10% roe content in the AYK Region was $200 per ton. The range of prices paid during the 1999 season was $200 to $500 per ton.

A total of 483 permit holders participated in the AYK sac roe herring fisheries during the 2000 season (Table 3). All districts, except Nunivak Island, exhibited decreases in participation compared to 1999. The number of AYK herring fishers participating in 2000 is two-thirds of the 5-year average (1995-1999) of 757 fishers and the lowest since 1993 when there was no commercial fishery in the Norton Sound District. Three beach seine fishers harvested herring and three fishers participated in the open pound spawn on kelp fishery in the Norton Sound District. In the Nunivak Island District 35 permit holders were registered in the cooperative purse seine fishery.

Surveyed subsistence fishermen from selected Yukon River coastal villages harvested approximately 6.2 tons of herring in 2000 (Table 4). No surveys were conducted in the Nelson Island or Nunivak Island villages. These villages have historically harvested approximately 110 tons of herring annually (Pete 1992).

Biomass projections are made for each district using postseason escapement estimates, historical mean rates of survival, current mean weights for each age class and assumed recruitment rates for

each age class (Wespestad 1982). The projected 2001 spawning biomass of the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) is 50,034 tons, with an allowable commercial harvest of 9,798 tons (Table 7). This is a slight decline from the 2000 biomass of 59,134 tons. All districts, except Cape Avinof, have small projected declines, partly due to natural mortality as the predominant year class ages. Cape Avinof has a small projected increase. These projections do not include age classes younger than age 4, not yet seen in the fishery.

Variability in survival rates and in aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Observed biomass estimates may be greater than expected if large numbers of recruit herring arrive in year 2001. Harvest levels may be adjusted inseason according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest strategy, the commercial fishery will not target newly recruited age classes. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from the projected biomass, test and commercial catches, and spawn deposition observations.

STOCK STATUS

Assessment Methods

The timing of the spawning migration of herring in the northeastern Bering Sea is greatly influenced by climate and oceanic conditions, particularly the extent and distribution of the Bering Sea ice pack. Most herring appear soon after ice breakup, which generally occurs between late-April and mid-June. Spawning usually begins in the Security Cove District and progresses in a northerly direction. In some areas, spawning may continue as late as July.

Aerial survey techniques have been used since 1978 in Bering Sea herring fisheries to estimate herring spawning biomass (Lebida and Whitmore 1985). However, it is often difficult to obtain biomass estimates from aerial surveys in the AYK Region because of poor survey conditions caused by unfavorable weather, ice conditions or turbid water. Herring school surface areas are recorded in 538 ft^2 relative abundance index (RAI) units. In the AYK Region, RAI units are converted to biomass based on water depth. Because purse seine gear is needed to estimate the conversion factors and purse seine gear use is limited in the AYK Region, conversion factors developed in the Togiak District were used. Ground surveys are conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

During 2000, 67 aerial surveys totaling 65.9 hours of flight time were flown in the AYK Region: 12 (5.4 hours) in Security Cove, 11 (7.4 hours) in Goodnews Bay, 0 in Cape Avinof, 10 (5.5 hours) in Nelson Island, 8 (5.0 hours) in Nunivak Island, 5 (0.6 hours) in Jacksmith Bay, 5 (2.4 hours) in

Cape Romanzof, 16 (39.6 hours) in Norton Sound and 0 in Port Clarence. Survey conditions were rated as fair or better in nearly one-half of these surveys.

Gillnets are the only legal gear in the majority of the AYK Region, with the exception of Norton Sound where a portion of the harvest is normally taken using beach seine gear and Nunivak Island where purse seine gear was fished cooperatively during the 2000 season. Additionally, Norton Sound recently established an open pound imported kelp and a wild kelp harvest. An attempt was made to sample at least 420 herring from each commercial gear type, district or subdistrict per week. The sampling goal for test fish catches was to sample a minimum of 60 herring per day or 420 per week from each district or subdistrict. Herring from test fish and commercial catches were sampled to estimate age, sex, size, and sexual maturity of herring, and to note the occurrence of other schooling fishes, in all but the Security Cove and Port Clarence Districts. Security Cove and Nunivak Island age composition summaries were compiled using samples from Goodnews Bay and Nelson Island, respectively. A total of 9,434 herring from commercial gillnet, commercial beach seine, commercial purse seine, subsistence and test catches were sampled during the 2000 fishing season.

In most districts, fishermen, in cooperation with the Department, provided catch samples for roe quality evaluation by industry representatives. Participation by fishermen in collecting samples, processor evaluation of samples, and the flexibility of fishermen to fish on short notice helped to increase roe recoveries.

Spawning Populations

Security Cove District

Since 1981, biomass estimates in the Security Cove District have ranged from 2,300 tons in 1987 to 8,267 tons in 1981 (Table 5). The herring biomass projected to return to this district in 2000 was 3,622 tons. Between May 2 and May 23, twelve aerial surveys were flown in the district to estimate herring biomass and observe spawning activity. Six of these surveys were flown under acceptable conditions. The largest biomass, 5,237 tons, was observed on May 13. The peak biomass estimate observed on May 13 was used as the biomass estimate for 2000. A total of 9.1 miles of spawn was observed in the district, with peak spawning activity (2.0 miles) observed on May 13.

Due to budget cuts, herring were not sampled from the Security Cove District. Age composition of the Security Cove District biomass was estimated using samples from the Goodnews Bay District. Ages 7, 9 and 10 herring comprised 16.8%, 14.9% and 14.3%, respectively, of the biomass (Figure 5). Ages 4 and 7 dominated the return in numbers of fish (25.0% and 16.4%, respectively). Age 9 and older herring comprised 51.6% of the biomass. Recruit herring, ages 2-5, represented 31.4% of the returning population (Figure 7).

Goodnews Bay District

Since 1981, biomass estimates in the Goodnews Bay District have ranged from 2,000 tons in 1987 to 6,896 tons in 1999 (Table 5). The herring biomass projected to return to this district in 2000 was 4,665 tons. During the 2000 season, eleven aerial surveys were flown in the district between May 2 and May 23 to estimate herring biomass and observe spawning activity. Five of these surveys were flown under acceptable conditions. The largest biomass, 6,348 tons, was observed on May 12 and used as the biomass estimate for 2000. Approximately 6.5 miles of spawn was observed in the district with the greatest amount (2 miles) observed on May 8.

The Department's test fish crew sampled 1,523 herring caught with variable-mesh gillnets from May 6 to May 26 for biological data. Ages 7, 9 and 10 herring comprised 16.8%, 14.9% and 14.3%, respectively, of the biomass (Figure 5). Ages 4 and 7 dominated the return in numbers of fish (25.0% and 16.4%, respectively). Age 9 and older herring comprised 51.6% of the biomass. Recruit herring, ages 2-5, represented 31.4% of the returning population (Figure 7).

Cape Avinof District

Since 1985, biomass estimates in the Cape Avinof District have ranged from 1,225 tons in 1987 to 4,600 tons in 1997 (Table 5). The herring biomass projected to return to this district in 2000 was 2,868 tons. Due to poor conditions, no aerial surveys were flown in the Cape Avinof District in 2000. Aerial survey estimates of herring biomass in the Cape Avinof District have been obtained in only two of the past ten years. The area consists of shallow mud flats where turbidity, caused by wind and wave action, often limits visibility. The last year in which the herring biomass was estimated by survey was 1992, when 3,446 tons were observed. In other years, the preseason projection or commercial catch rates have been used to estimate herring biomass. Due to poor aerial survey conditions in 2000, the total biomass present in the district was based on the preseason estimate and catch rates during the fishery and assessed to be 3,210 tons.

The Cape Avinof test fish crew sampled 554 herring caught with variable-mesh gillnets from June 1 to June 7 for biological data. Age 4 herring dominated both the biomass (28.2%, Figure 5) and the return in numbers of fish (44.3%). Age 9 and older herring comprised 27.9% of the biomass. Cape Avinof had the largest component of recruit herring, 63.7%, of any district in the region (Figure 7).

Nelson Island District

Since 1985, biomass estimates in the Nelson Island District have ranged from 2,385 tons in 1991 to 9,500 tons in 1985 (Table 5). The herring biomass projected to return to this district in 2000 was 4,672 tons. During the 2000 season, ten aerial surveys were flown between May 16 and June 8 to

estimate herring biomass and observe spawning activity. Three of these surveys were flown under acceptable conditions. The largest biomass, 3,086 tons, was observed on May 29 under poor conditions. Due to poor aerial survey conditions in 2000, the preseason estimate was used as the biomass estimate for 2000. Approximately 1.5 miles of spawn was observed in the district with the greatest amount (0.8 miles) observed on May 26.

Test fishing with variable-mesh gillnets occurred from May 21 through June 13. The crew sampled 1,214 herring caught in variable-mesh gillnets for biological data. Age 7 herring dominated the biomass (25.2%, Figure 5) and the return in numbers of fish (23.8%). Age 9 and older herring comprised 38.8% of the biomass. Recruit herring represented 28.1% of the spawning population (Figure 7).

Nunivak Island District

Since 1985, biomass estimates in the Nunivak Island District have ranged from 422 tons in 1990 to 6,000 tons in 1986 (Table 5). The herring biomass projected to return to this district in 2000 was 2,823 tons. During the 2000 season, eight aerial surveys were flown between May 16 and May 26 to estimate herring biomass and observe spawning activity. Two of these surveys were flown under acceptable conditions. The largest biomass, 2,753 tons, was observed on May 24 under fair conditions. Total biomass in the district was estimated to be 3,847 tons based on aerial surveys. A total of 5.7 miles of spawn was observed in the district, with peak spawning activity observed on May 21 (1.8 miles).

Due to budget cuts, test fishing with variable-mesh gillnets has been discontinued in the Nunivak Island District. Age composition of the Nunivak Island herring biomass was estimated using samples from the Nelson Island District. Age 7 herring dominated the biomass (25.2%, Figure 6) and the return in numbers of fish (23.8%). Age 9 and older herring comprised 38.8% of the biomass. Recruit herring represented 28.1% of the spawning population (Figure 7).

Central Kuskokwim Bay

The Central Kuskokwim Bay area extends from Jacksmith Bay, south of Quinhagak, to the Ishkowik River. No commercial herring fishing districts are located in this area. Five aerial surveys were flown in this area from May 2 to May 12. Two of these surveys were flown under acceptable conditions. The largest biomass, 209 tons, was observed on May 12 under fair conditions.

Cape Romanzof District

Due to excessive water turbidity in the Cape Romanzof area, it is not generally possible to estimate herring biomass using aerial survey techniques. Based on information from limited aerial surveys, test and commercial catches, and spawn deposition, the estimated herring biomass in the Cape Romanzof District has ranged from approximately 3,500 to 7,500 tons since 1981 (Table 5). Five aerial surveys were flown during the 2000 season from May 22 through June 9. The largest biomass, 412 tons, was observed on June 3 under fair conditions. No spawn was observed in the district. Based on spawn deposition study results, commercial and test fishery catch rates, herring age composition and the preseason projection, the 2000 biomass of herring in the Cape Romanzof District was estimated to be between 3,000 and 4,000 tons. This is a decrease from the 1999 biomass estimate of between 3,300 and 4,300 tons.

Artificial spawning substrates were located in the same general spawning locations as in 1992 through 1999. Forty platforms were placed just north of the Department's field camp on May 16 and 17. Spawn deposited on the substrate was removed at low tide and weighed daily. Daily removal of spawn allowed measurements of new spawn deposition and decreased the problem of spawn loss due to wave action and desiccation. Spawn deposition occurred on May 29 and June 4-7, with peak deposition recorded on June 5. This season was unique in that there were five significant spawn deposition events, four of which took place on consecutive days. In past years, there were normally two or three temporal spawn deposition events. The total spawn deposition index of 8,455 g was the highest since the project began in 1992, and was 88% above the 5-year average (1994-1996 and 1998-1999) of 4,494 g. However, it is uncertain whether the study area results are indicative of the total spawning biomass within the entire district.

The Department's test fish crew sampled 738 herring caught with variable-mesh gillnets from May 28 to June 7 for biological data. Age 7 herring dominated the return in both biomass (22.7%, Figure 6) and numbers of fish (23.4%). Age 9 and older herring comprised 61.9% of the biomass. The Cape Romanzof District had the oldest average-age herring (8.2 years) of any district in the region. Recruit herring represented 23.0% of the spawning population (Figure 7).

Norton Sound District

Historically, the primary spawning areas within Norton Sound have been from Stuart Island to Tolstoi Point (Figure 2). The herring spring migration was unusual this year because shorefast ice lingered in the preferred spawning areas between Wood Point to Whale Island including St. Michael Bay while the remainder of Norton Sound warmed at a normal rate.

Since 1978, herring biomass estimates in the Norton Sound District have ranged from 5,291 tons in 1978 to 57,974 tons in 1992 (Table 5). During 2000, 16 surveys were flown between May 22

and June 14. Survey conditions were generally poor. Significant breakup of shorefast ice began on May 29. Herring were first sighted during an aerial survey on June 3. Spawning was first observed June 5, along the west side of Stuart Island, which is typically the last location to receive spawn. The peak aerial survey estimate of 28,193 tons was calculated by combining one survey on June 12 in Subdistricts 4, 5, and 6 with a survey on June 13 in Subdistricts 1, 2, and 3. The peak survey, which counted primarily spawned-out fish, occurred late in the season because of poor survey conditions earlier in the migration. The peak aerial survey estimate was combined with the harvests up to June 13 to provide a biomass estimate of 32,680. This biomass estimate represents 55.3% of the AYK total biomass (Figure 3). The preseason biomass estimate was 26,924 tons. Twenty-three and a half miles of spawn were observed with the greatest amount (5.2 miles) on June 5.

Two Department test fish projects were operational during the 2000 season. One crew operated in the northern portion of Norton Sound at Cape Denbigh, and the second crew was stationed in the southern end of the district at Klikitarik. Test fishing was conducted in the Unalakleet area by staff as time allowed. Test fish crews sampled 2,349 herring caught with variable-mesh gillnets from June 1 through June 16 for biological data. Age 7 herring dominated the return in biomass (25.7%, Figure 6). Ages 4 and 7 were the largest components in numbers of fish (24.9% and 24.5%, respectively). The biomass consisted of 54.1% age 9 and older herring. Recruit herring represented 35.0% of the return in numbers of fish (Figure 7).

Port Clarence District

Generally, it is not possible to survey this district due to the presence of ice, poor water clairty, or poor weather. In addition, it is difficult to identify herring due to the large numbers of saffron cod, whitefish, and other pelagic species typically present in the area. The record biomass for this district of 1,652 tons was sighted during an aerial survey in 1992. No surveys were flown in the Port Clarence District during 2000.

SUBSISTENCE FISHERY

Pacific herring are an important component of the diet of residents of many Yukon-Kuskokwim Delta villages. Surveys of subsistence harvests have been conducted annually in Yukon Delta villages and sporadically in Kuskokwim Delta villages since 1975. In the Nelson and Nunivak Island Districts subsistence surveys have been conducted during several years since 1990 by Subsistence Division (Pete 1990, 1991, 1992, 1993). However, no herring subsistence surveys have been conducted in those districts since 1996 (Table 4). Available data suggest that Nelson Island villages harvest approximately 110 tons of herring annually (Pete 1992).

A total of 421 herring were sampled for biological data from the subsistence beach seine and gillnet catch in the Nelson Island District. Age 7 herring dominated the subsistence catch (30.5%). The catch consisted of 15.8% age 9 and older herring and 26.2% recruit-aged herring.

A combination of mail-out questionnaires and personal interviews were used to collect subsistence harvest information from the Yukon Delta villages of Hooper Bay, Chevak, and Scammon Bay in 2000. Fifty households returned herring questionnaires out of a total of 212 households that were mailed questionnaires. Thirty-two of the households that did not return questionnaires were subsequently interviewed as well as 15 others. A total of 97 households were contacted out of 227 attempted. The reported subsistence harvest was 6.2 tons of herring taken by 50 fishing households from Yukon Delta villages (Table 4). In addition, 30 households harvested 1,109 pounds of herring spawn on *Fucus* kelp for subsistence use. The subsistence harvest and effort figures represent only the harvest that was reported. Therefore, the reported harvest is a minimum estimate since not all fishing families were contacted and not all households who received questionnaires returned them.

COMMERCIAL FISHERY

Security Cove District

The total harvest of 299 tons had an average roe content of 10.7% (Tables 1 and 2). There were 15 tons of bait-quality herring delivered and no waste was reported. Ten processors purchased herring from 79 permit holders who made 162 deliveries in five periods with 16 hours of total fishing time (Tables 3 and 6). The estimated ex-vessel value was $62,000. The Guideline Harvest Level (GHL) was raised to 1,048 tons based on the May 13 aerial survey estimate of 5,237 tons. The exploitation rate was 5.7%.

On May 13, the first period opened for two hours starting at 4:30 PM. Twenty-four permit holders delivered 18 tons of sac roe quality herring with an average roe content of 9.3% and 14 tons of bait quality herring. The second and third periods both occurred on May 18 with a combined harvest of 264 tons. The final two periods occurred on May 19 with a combined harvest of two tons. Fishers were allowed to use 100 fathoms of gillnet during all openings. The spring spawning migration timing was relatively early and tenders from the Togiak District were late in arriving. The allowable harvest was not taken because fishers had difficulty locating quantities of herring with acceptable sac-roe recovery rates.

Due to budget cuts, herring were not sampled from the Security Cove commercial harvest. Samples from the Goodnews Bay commercial catch were used to estimate the age composition of the Security Cove harvest biomass. Ages 9 and 10 herring dominated the harvest biomass (23.4% and 23.0%, respectively, Figure 5). Age 9 and older herring made up 71.4% of the catch. Recruit-age herring were not present in the commercial sample.

Goodnews Bay District

The total herring harvest was 20 tons with an average roe content of 9.2% (Tables 1 and 2). There was 1 ton of bait-quality herring delivered and 1 ton of wasted herring. Two processors bought herring from 57 permit holders who made 87 deliveries in five periods from May 18 through May 28 with 28 hours total fishing time (Tables 3 and 6). The estimated ex-vessel value was $3,000. The GHL was raised to 1,270 tons based on the May 12 aerial survey estimate of 6,348 tons. The exploitation rate was 0.3% of the available biomass.

On May 18, the first period began at 6:30 PM for 4 hours. Nine permit holders delivered 2 tons of herring with an average roe content of 3.9%. Fishing was suspended until May 26 because of low roe quality. Between 3:30 PM on May 26 and 12:00 PM on May 28, the district was reopened four times for a total of 24 hours of fishing time. Harvests ranged from 1 ton on May 27-28 when bad weather resulted in low fisher participation, to 8 tons on May 26. The spring spawning migration timing was relatively early in 2000. The allowable harvest was not taken because fishers had difficulty locating quantities of herring with acceptable sac-roe recovery rates.

A sample of 100 herring was taken from the commercial catch. Ages 9 and 10 herring dominated the harvest biomass (23.4% and 23.0%, respectively, Figure 5). Age 9 and older herring made up 71.4% of the catch. Recruit-age herring were not present in the commercial sample.

Cape Avinof District

The total herring harvest was 377 tons with an average roe content of 9.6% (Tables 1 and 2). Bait-quality herring accounted for 7 tons of the harvest. One processor bought herring from 86 permit holders who made 399 deliveries in ten periods with a total fishing time of 58 hours (Tables 3 and 6). The estimated ex-vessel value was $71,000. The exploitation rate was 11.8% based on the postseason biomass projection of 3,210 tons.

On June 4 the first period opened for four hours starting at 11:00 AM. Twenty-three permit holders landed 6 tons of herring with an average roe content of 9.3% and 1 ton of bait-quality herring. Between June 5 and June 10 the district was reopened nine times for a total of 54 hours of fishing time. Catches ranged from 2 tons on June 6 to 98 tons on June 8 (Table 6). Average roe contents ranged from 9.1% to 10.4%.

A total of 219 herring were sampled from the commercial catch. Ages 9 and 7 herring dominated the harvest biomass (24.0% and 23.0%, respectively, Figure 5). Age 9 and older herring made up 55.5% of the catch. Recruit-age herring comprised 1.0% of the harvest.

Nelson Island District

The total harvest was 807 tons of herring with an average roe content of 9.8% (Tables 1 and 2). There were 52 tons of bait-quality herring delivered and 1 ton of wasted herring. Four processors purchased herring from 86 permit holders who made 354 deliveries in four periods with a total fishing time of 20 hours (Tables 3 and 6). The estimated ex-vessel value was $150,000, slightly greater than the combined value from all other Kuskokwim Districts (Table 2). The exploitation rate was 17.3% of the available biomass.

On May 28 the first period opened for four hours starting at 6:00 PM. The harvest consisted of 24 tons of sac roe quality herring with an average roe content of 10.2% and 2 tons of bait-quality herring. Between May 29 and May 30 the district was reopened three times for a total of 16 hours of fishing time. Catches ranged from 170 tons on the morning of May 30 to 427 tons on the evening of May 30 (Table 6). Gear was restricted to 50 fathoms per boat during the first three periods due to persistent ice conditions. One hundred fathoms of gear was allowed for the final period.

A total of 442 herring were sampled from the commercial catch. Age 9 was the largest age class, comprising 33.6% of the harvest (Figure 5). Age 9 and older herring made up 74.9% of the catch. Recruit-age herring were not present in the commercial sample.

Nunivak Island District

All herring in the Nunivak Island District were harvested in the cooperative purse seine fishery. The fishery was opened May 20 at 8:00 PM shortly after the purse seine vessel arrived on the grounds. Fishing was open continuously until May 24 when herring quality declined. Herring were captured in 20 of 23 purse seine sets. Three sets were retained, and resulted in a harvest of 41 tons with an average roe recovery of 9.9% (Tables 1 and 2). The remaining sets were released after testing indicated roe percentages or average fish size that were below processor minimums. Thirty-five members of the Nunivak Island Herring Fishermen's Association, one purse seine vessel and one processor participated in the fishery (Table 3). The estimated ex-vessel value was $12,000 and the exploitation rate was 1.2% of the available biomass.

A total of 100 herring were sampled from the commercial catch. Age 9 was the largest age class, comprising 29.2% of the harvest (Figure 6). Age 9 and older herring made up 62.8% of the catch. Recruit-age herring comprised 2.0% of the commercial sample.

Cape Romanzof District

Forty-six fishers harvested a total of 500 tons of herring in 2000 (Tables 1, 2 and 3). The commercial harvest was 27% below the recent five-year average (1995-1999) of 686 tons. Sac roe comprised 63%, or 313 tons of the harvest. The average sac roe recovery was 9.1%. A total of 187 tons of herring were purchased as bait with an average roe recovery of 6.5%. The excessive amount of bait herring was due to the incidence of partially spawned out females occurring in the commercial catch. During recent years, early test fishing samples have been good and it will be important to be ready to fish earlier on the herring migration in the future. The commercial harvest reached near the midpoint of the preseason harvest projection of 463 to 563 tons. The commercial fishery consisted of five fishing periods, between May 29 and June 4 (Table 6). Fishing periods ranged from 1.5 hours to 3.5 hours in duration for a total fishing time of 13.0 hours. Fishing gear was restricted to one 50-fathom gillnet per vessel throughout the commercial season.

The estimated value of the harvest to fishers was $77,000 (Table 2). This is the lowest value in the Cape Romanzof herring fishery on record. Average price for herring sac roe was $200 per ton at 10% roe recovery. The bait herring averaged $71 per ton to fishers. Two companies purchased herring, represented by one processing vessel and six tenders during the fishery (Table 3).

Fishing effort was 16% below the five-year average (1995-1999) of 55 fishers. Local Alaskan residents (defined as residents of Chevak, Hooper Bay, and Scammon Bay) accounted for 98% (45 permits) of the effort and 98% (490 tons) of the harvest (Table 2). Fishermen harvested an estimated 14.3% of the available biomass (Table 2).

A total of 575 herring were sampled from the commercial harvest. Ages 12 and 9 herring dominated the harvest biomass (22.8% and 21.4%, respectively, Figure 6). Age 9 and older herring made up 81.4% of the catch. Recruit-age herring comprised less than 1% of the harvest.

Norton Sound District

Sac Roe Fishery

The total harvest during the sac roe fishery was 4,487 tons of herring with an average roe recovery of 9.4% (Tables 1, 2 and 6). There were 15 tons of wasted herring observed in abandoned nets after the fishery closed. The 2000 harvest was similar to the 5-year average (1995-1999) harvest of 4,472 tons. This was the largest harvest since 1996 and represented 68.7% of the total AYK harvest (Figure 4). Fishers harvested an estimated 13.7% of the available biomass. Only 91 gillnet and 3 beach seine fishers of a possible 320 permit holders participated in the fishery (Table 3).

The gillnet fishery was first opened in Subdistricts 1 and 3 on June 7. Seven additional periods were allowed on a daily basis from June 9 through June 15 for a total of 89 hours of fishing time (Table 6). The total sac roe harvest by gillnet was 4,405 tons. Several periods were restricted to one 50-fathom gillnet per fishing vessel primarily to maintain roe quality.

A total of 81 tons of sac roe herring was harvested by beach seine (Tables 6 and 8). Seven beach seine openings were allowed from June 7 through June 11 for a total of 26 hours of fishing time. Numerous sets were released due to the dominance of small size herring. Beach seine fishers ended their season short of their allocation because they were unable to selectively harvest larger and older herring preferred by the market. Table 8 presents the historical beach seine and gillnet commercial catches in the Norton Sound District.

Four companies were present on the grounds during the season to purchase herring. These four companies registered five processors and 18 tenders to operate in Norton Sound (Table 3). Based on final operations reports, the average price advanced was $200 per ton at 10% roe recovery. The total value of the herring harvest to Norton Sound fishers was $894,000, approximately 44% of the five-year (1995-1999) average of $2,041,000.

A total of 981 herring were sampled from the commercial harvest. Age 12 herring dominated the harvest, comprising 44.1% of the catch by weight (Figure 6). Age 9 and older herring represented 88.0% of the catch. Recruit-age herring comprised less than 1% of the harvest.

Spawn on Kelp Fisheries

Two herring spawn on kelp fisheries are allowed under regulation, a spawn on imported *Macrocystis* kelp open pound fishery and a spawn on wild *Fucus* kelp fishery (5 AAC 27.965 and 5 AAC 27.934, ADF&G 1999). Due to lack of interest the spawn on wild *Fucus* kelp fishery did not occur in 2000.

Five permit holders registered as participants in the third year of the *Macrocystis* kelp open pound fishery. Effort declined from 1999 due to the improving market for sac roe herring and the increased risk associated with the *Macrocystis* kelp fishery. In 2000, only three permit holders actually deployed kelp and harvested 4,500 pounds of product (Table 6).

Timing is one of the most critical factors in the open pound fishery. The operators must predict spawning, at least five days in advance, to allow adequate time for the *Macrocystis* kelp to be harvested in southeast Alaska, delivered and deployed in pounds. This year the main wave of spawn began on June 5, four days before *Macrocystis* kelp was hung in the water. Some small schools did eventually spawn on the *Macrocystis* kelp and all harvesting was completed by June 15. The quantity of product was low, but quality was good. Although the spawn on *Macrocystis* kelp product has been processed, the final sales are not complete and value figures are not yet available.

Port Clarence District

There has not been a commercial sac roe fishery in the Port Clarence District since 1988 because buyers have not been present in the district. A small bait fishery with a harvest of less than 10 tons occurs in most years. However, there was no bait fishery in Port Clarence in 2000.

ENFORCEMENT

The Division of Fish and Wildlife Protection (FWP) was present in Security Cove, Goodnews Bay, and Norton Sound Districts this year. Officers were not present in the Cape Avinof, Nelson Island and Cape Romanzof Districts during 2000. Most fishers followed fishery period opening and closing times very well and buyers were timely and accurate with verbal reporting of purchases. Two FWP officers were involved in Kuskokwim Bay herring fisheries. Enforcement officers utilized one Supercub aircraft and a small helicopter. Details on the number and type of violations observed are not available from FWP at this time. Protection efforts in Norton Sound consisted of two single engine aircraft and a small boat. Personnel consisted of two FWP officers. Three citations were issued all relating to fishing after the close of a fishing period.

OUTLOOK AND MANAGEMENT STRATEGY FOR 2001

Projections from postseason escapement estimates suggest that the year 2001 spawning biomass for northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be 50,034 tons, with an anticipated allowable harvest of 9,798 tons (Table 7). The methods for projecting herring returns in the AYK region are described in Hamner and Bromaghin (1999). If the return is as expected, a small reduction in biomass will be observed in all districts except Cape Avinof. This decline is primarily due to natural mortality as the dominant year classes age.

Variability in the quality of aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Therefore, harvest levels may be adjusted during the season according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest strategy, newly recruited age classes (age 2 through age 5 herring) will not be targeted by the commercial fishery. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from the projected biomass, test and commercial catches and spawn deposition observations. In all districts, the Department will cooperatively work with fishermen and buyers to optimize roe recovery during the 2001 season.

Security Cove District

The year 2001 projected return to the Security Cove District is 4,527 tons. A 20% exploitation rate would result in a harvest of 905 tons (Table 7). Actual catch will depend on inseason abundance assessments. Commercial fishing will not be allowed until the observed biomass reaches 1,200 tons, or significant spawning activity is observed. The occurrence and length of fishing periods will depend on stock strength, fishing effort, and spawning activity.

Due to budget cuts, age composition data was not collected from the Security Cove District in 2000. The estimated year 2001 herring age composition was calculated using data from the Goodnews Bay District. Ages 5, 8 and 10 are expected to comprise over one-half the returning biomass (20.1%, 18.1% and 13.7%, respectively). Age 9 and older herring are expected to comprise one-half of the biomass.

Goodnews Bay District

The management strategy for this district will be similar to that planned for Security Cove. The season will open and close by emergency order when a biomass of 1,200 tons is observed, or significant spawning activity is observed. The year 2001 projected return of herring to the Goodnews Bay District is 5,755 tons. A 20% exploitation rate would result in a harvest of 1,151 tons (Table 7). Actual catch will depend on inseason abundance assessments.

Ages 5, 8, and 10 herring are expected to dominate the biomass, contributing 19.1%, 18.0%, and 14.2%, respectively. Age 9 and older herring are expected to comprise approximately one-half of the biomass.

Cape Avinof District

Either significant spawning activity or a biomass of 500 tons must be observed before the commercial herring season can be opened. The projected year 2001 biomass for the Cape Avinof District is 3,486 tons (Table 7). This is the only district in the region with an increasing biomass projection, primarily due to a large component of age-5 herring expected to return in 2001. The exploitation rate will be no greater than 15% because of the limited database for this area and the priority of subsistence fishing. Assuming a 15% commercial exploitation rate, the projected harvest will be 523 tons of herring. Actual catch will depend on inseason abundance assessments.

Ages 5, 8 and 4 are expected to comprise almost two-thirds the returning biomass (38.8%, 13.7% and 10.7%, respectively). Age 9 and older herring are expected to comprise one-fifth of the biomass.

Nelson Island District

In the Bering Sea Herring Fishery Management Plan, the Alaska Board of Fisheries set a minimum biomass threshold of 3,000 tons for the Nelson Island District. The inseason estimate of herring biomass must exceed the threshold level before a commercial fishery can be allowed.

The spawning biomass projected to return to the Nelson Island District in year 2001 is 3,971 tons (Table 7). At an exploitation rate of 20% minus 200 tons for subsistence harvest, the commercial harvest will be 594 tons of herring. Actual catch will depend on inseason abundance assessments.

To provide additional protection for the subsistence harvest of herring, the following guidelines will be followed:

1. Two hundred tons of the exploitable biomass will be set aside for subsistence.
2. Periodic closures of the commercial fishery will be scheduled, during which only subsistence fishing will be allowed.
3. Several important subsistence use areas occur throughout the district, including the waters around Cape Vancouver. Specific areas may be closed to commercial fishing to insure the adequacy of subsistence harvests.
4. The Department will by all available means, including acting on input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

Ages 8, 5 and 9 are expected to dominate the returning population, contributing 26.4%, 14.5%, and 13.3%, respectively. Age 9 and older herring are expected to comprise over one-third of the biomass.

Nunivak Island District

The biomass of herring projected to return to the Nunivak Island District in year 2001 is 3,411 tons. A 20% exploitation rate would result in a 682-ton harvest (Table 7). Actual catch will depend on inseason abundance assessments. A larger catch may occur if the 2001 biomass is assessed to be greater than projected. The commercial season will open when the biomass reaches 1,500 tons, or when significant spawning is observed.

Due to budget cuts, variable-mesh gillnet test fishing did not occur in the Nunivak Island District in 2000. Estimates for year 2001 age composition were calculated using variable-mesh gillnet data from the Nelson Island District and commercial catch data from the Nunivak Island District. Ages 8, 10 and 9 are expected to comprise over one-half the returning biomass (25.0%, 14.5% and 13.0%, respectively). Age 9 and older herring are expected to contribute 44% of the return.

Cape Romanzof District

The projected return for year 2001, based on limited data, is expected to be between 2,079 and 3,079 tons based on an assessed biomass of between 3,000 and 4,000 tons in 2000. The midpoint of this range for 2000 was 3,500 tons, which results in a projected biomass of 2,579 tons. At a 20% exploitation rate, the harvest based on this projection would be 516 tons (Table 7). The allowable harvest is expected to range from approximately 466 to 566 tons and will be based on inseason indicators of abundance. It is probable that fishing gear will be restricted to no more than 50 fathoms and one gillnet per vessel by emergency order. Since water turbidity in the Cape Romanzof area generally prevents aerial observations of herring, spawn deposition and test and commercial catch rates will be used to determine the timing and duration of commercial fishing periods.

Ages 8, 10, and 11 herring are expected to dominate the biomass, contributing 26.2%, 15.8%, and 13.4%, respectively. Age 9 and older herring are expected to comprise one-half of the return.

Norton Sound District

The biomass projected to return to Norton Sound in year 2001 is 26,305 tons. A 20% exploitation rate would result in a harvest guideline of 5,261 tons (Table 7). A maximum of 320 tons of herring are reserved to allow for the pound fishery to harvest a maximum of 90 tons (5AAC 27.965, ADF&G 1999). The sac roe harvest remaining is 4,941 tons. The beach seine harvest is, by regulation, 10% of the sac roe projected harvest, or 494 tons. Inseason assessment of herring biomass will supersede projected biomass for management of the Norton Sound herring fishery, except where weather prevents obtaining an inseason estimate.

The year 2001 herring fishery will be opened by emergency order. The fishery will close by emergency order when up to 20% of the available herring biomass has been harvested. Varied harvest rates may be applied to individual subdistricts based on biomass distribution, roe quality, weather, and sea ice conditions.

Ages 8 and 5 are expected to comprise nearly one-half the returning biomass (27.7% and 20.2%, respectively). Age 9 and older herring are expected to contribute over 40% of the return.

Port Clarence District

The Department does not generally project an outlook for the Port Clarence fishery due to the lack of data on Port Clarence herring and the very limited scope of the fishery. The guideline harvest of 165 tons established by the Board of Fisheries in 1981 will determine the allowable harvest in 2001. This harvest guideline is based on two years research by the Department in both the Port Clarence and Kotzebue Districts. Even though this guideline has not appeared in the regulation book since 1984, it still represents the best estimate of harvestable biomass at this time.

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Table 1. Pacific herring harvests by commercial fishermen during the sac roe fisheries in the northeastern Bering Sea, Alaska, 1909-2000.

	Herring (st) [a]									Spawn on Kelp (st)
Year	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof	Norton Sound	Port Clarence	Total Harvest	Norton Sound
1909-1916	-	-	-	-	-	-	[b]	-	-	-
1916-1928	-	-	-	-	-	-	1,881	-	1,881	-
1929	-	-	-	-	-	-	166	-	166	-
1930	-	-	-	-	-	-	441	-	441	-
1931	-	-	-	-	-	-	86	-	86	-
1932	-	-	-	-	-	-	529	-	529	-
1933	-	-	-	-	-	-	31	-	31	-
1934	-	-	-	-	-	-	4	-	4	-
1935	-	-	-	-	-	-	15	-	15	-
1936	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	6	-	6	-
1938	-	-	-	-	-	-	10	-	10	-
1939	-	-	-	-	-	-	6	-	6	-
1940	-	-	-	-	-	-	14	-	14	-
1941	-	-	-	-	-	-	3	-	3	-
1942-1944	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-
1947-1963	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	20	-	20	-
1965	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	12	-	12	-
1967	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	2	-	2	-
1970	-	-	-	-	-	-	8	-	8	-
1971	-	-	-	-	-	-	20	-	20	-
1972	-	-	-	-	-	-	17	-	17	-
1973	-	-	-	-	-	-	35	-	35	-
1974	-	-	-	-	-	-	2	-	2	-
1975	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	9	-	9	-
1977	-	-	-	-	-	-	11	-	11	<1
1978	286	-	-	-	-	-	15	-	301	4
1979	424	90	-	-	-	-	1,292	-	1,806	13
1980	697	448	-	-	-	611	2,452	-	4,208	24
1981	1,173	657	-	-	-	720	4,371	-	6,921	47
1982	813	486	-	-	-	657	3,933	-	5,889	38
1983	1,073	435	-	-	-	816	4,582	-	6,906	29
1984	335	717	-	-	-	1,185	3,662	-	5,899	19 [c]
1985	733	724	-	977	358	1,299	3,548	-	7,639	-
1986	751	557	-	886	511	1,865	5,194	-	9,764	-
1987	313	321	-	923	414	1,342	4,082	146	7,541	-
1988	324	483	348	775	-	1,119	4,672	80	7,801	-
1989	554	616	129	233	116	926	4,771	-	7,345	-
1990	234	455	50	-	-	329	6,439	-	7,507	-
1991	570	263	267	-	59	526	5,672	-	7,357	-
1992	834	740	451	246	27	530	-	-	2,828	-
1993	5	954	215	739	-	371	5,079	-	7,363	-
1994	-	1,062	427	717	14	456	960	-	3,636	-
1995	1,292	1,054	485	1,113	41	541	6,773	-	11,289	-
1996	1,859	1,204	820	1,030	101	752	6,220	-	11,986	-
1997	892	805	687	778	0	879	3,976	-	8,017	-
1998	1,012	831	656	1,250	202 [d]	727	2,632 [e]	-	7,310	9 [f]
1999	1,072	1,366	533	1,366	-	533	2,760 [g]	-	7,630	4 [h]
2000	299	20	377	807	41	500	4,487	-	6,531	2

a Pre-1964 harvest primarily in summer and fall for food; post 1964 harvest primarily in spring for sac roe. Wastage is included.
b Fishery occurred some years but harvest data unavailable.
c Additional 3 st harvested from imported kelp (*Macrocystis* sp.) not included.
d Includes 200 st harvested with purse seine during aerial survey calibration study.
e Includes 8.3 tons harvested during a directed bait fishery.
f Includes 2,100 lbs of wild kelp and 16,083 lbs of *Macrocystis* kelp (preliminary numbers).
g Includes 8.3 tons harvested during a directed bait fishery.
h 7,482 lbs of *Macrocystis* kelp (preliminary numbers).

Table 2. Estimated biomass and commercial harvest of Pacific herring in northeastern Bering Sea fishing districts, Alaska, 1993-2000.

Year	District	Estimated Biomass(st)	Harvest (st) Sac roe	Bait	Waste	Total	Roe %	Estimated Value ($ x 1,000)	Exploitation Rate (%)
2000	Security Cove	5,237	284	15	0	299	10.7	62	5.7
	Goodnews Bay	6,348	19	1	1	20	9.2	3	0.3
	Cape Avinof	3,210 [a]	370	7	0	377	9.6	71	11.8
	Nelson Island	4,672 [a]	754	52	1	807	9.8	150	17.3
	Nunivak Island	3,487	41	0	0	41	9.9	12	1.2
	Cape Romanzof	3,500 [a]	313	187	0	500	9.1	77	14.3
	Norton Sound	32,680	4,472	0	15	4,487	9.4	894 [c]	13.7
Total		59,134	6,252	262	17	6,531	9.5	1,269	11.0
1999	Security Cove	5,261	1,016	56	1	1,072	11.0	338	20.4
	Goodnews Bay	6,896	1,332	33	0	1,366	11.3	301	19.8
	Cape Avinof	3,555 [a]	516	18	0	533	11.0	185	15.0
	Nelson Island	6,655	1,267	97	2	1,366	11.2	430	20.5
	Nunivak Island [b]	3,315 [a]	-	-	-	-	-	-	-
	Cape Romanzof	3,800 [a]	378	155	0	533	10.2	127	14.0
	Norton Sound	34,314	2,702	53	5	2,760	10.5	615 [c]	8.0
Total		63,800	7,211	412	8	7,630	10.9	1,996	12.0
1998	Security Cove	4,017 [a]	1,012	0	0	1,012	11.5	232	25.2
	Goodnews Bay	4,064 [a]	831	0	0	831	11.3	118	20.5
	Cape Avinof	4,287 [a]	656	0	0	656	11.8	152	15.3
	Nelson Island	7,136 [a]	1,250	0	0	1,250	11.8	290	17.5
	Nunivak Island	3,778 [a]	202 [d]	0	0	202	9.8	26 [e]	5.4
	Cape Romanzof	4,500 [a]	617	110	0	727	10.0	131	16.2
	Norton Sound	52,033	2,624	8	0	2,632	9.2	203 [c]	5.1
Total		79,815	7,192	118	0	7,310	10.2	1,158	9.2
1997	Security Cove	4,640 [a]	884	3	5	892	12.5	221	19.2
	Goodnews Bay	4,752 [a]	805	0	0	805	14.2	228	16.9
	Cape Avinof	4,600 [a]	687	0	0	687	11.5	157	14.9
	Nelson Island	7,900 [a]	778	0	0	778	12.7	198	9.8
	Nunivak Island	3,801 [a]	0	0	0	0	-	-	0
	Cape Romanzof	5,000 [a]	879	0	0	879	10.2	186	17.6
	Norton Sound	47,791	3,709	263	5	3,976	9.9	612	8.3
Total		78,484	7,742	266	10	8,017	11.1	1,602	10.2
1996	Security Cove	6,867	1,795	59	5	1,859	11.6	1,251	27.1
	Goodnews Bay	6,315	1,191	13	0	1,204	12.5	895	19.1
	Cape Avinof	4,500 [a]	820	0	0	820	13.4	659	18.2
	Nelson Island	6,638 [a]	986	44	0	1,030	11.4	679	15.5
	Nunivak Island	4,195 [a]	61	40	0	101	9.9	39	2.4
	Cape Romanzof	6,000 [a]	750	1	0	752	10.6	638	12.5
	Norton Sound	27,307 [a]	6,061	109	50	6,220	10.6	4,569	22.8
Total		61,822	11,664	266	55	11,986	11.2	8,730	19.4
1995	Security Cove	6,702 [a]	1,292	0	0	1,292	12.3	958	19.3
	Goodnews Bay	4,219 [a]	1,051	0	3	1,054	13.5	848	25.0
	Cape Avinof	3,627 [a]	485	0	0	485	12.5	363	13.4
	Nelson Island	7,754	1,113	0	0	1,113	10.6	710	14.3
	Nunivak Island	4,579 [a]	33	7	0	41	11.0	22	0.9
	Cape Romanzof	5,000 [a]	541	0	0	541	10.1	328	10.8
	Norton Sound	37,779	6,847	116	10	6,773	10.4	4,208	17.9
Total		69,660	11,162	123	13	11,299	11.0	7,433	16.2
1994	Security Cove [b]	7,638 [a]	-	-	-	-	-	-	-
	Goodnews Bay	5,879 [a]	1,061	0	1	1,062	12.3	391	18.7
	Cape Avinof	2,827 [a]	427	0	0	427	12.2	156	15.1
	Nelson Island	5,564	713	4	0	717	11.0	235	12.9
	Nunivak Island	4,921	14	0	0	14	8.8	4	0.3
	Cape Romanzof	5,000 [a]	456	0	0	456	9.2	124	9.1
	Norton Sound	37,829	958	2	0	960	10.3	271	2.5
Total		69,458	3,629	6	1	3,636	11.1	1,181	5.2
1993	Security Cove	6,995	5	0	0	5	12.8	2	0.1
	Goodnews Bay	6,211	945	9	0	954	10.3	293	15.4
	Cape Avinof	2,837 [a]	206	9	0	215	12.0	75	7.6
	Nelson Island	4,944	613	52	74	739	10.8	198	14.9
	Nunivak Island [b]	5,176	-	-	-	-	-	-	-
	Cape Romanzof	4,000 [a]	371	0	0	372	9.6	110	9.3
	Norton Sound	46,549	4,713	321	45	5,079	9.9	1,411	10.9
Total		76,712	6,853	391	119	7,363	10.1	2,089	9.6

a Inseason biomass estimate from poor aerial survey, therefore projected biomass or some other method of estimating biomass was used.
b No commercial fishery.
c Includes values from sac-roe fishery only, does not include directed bait, or kelp fisheries values.
d Includes 200 tons from the purse seine catch associated with an aerial survey calibration study.
e Includes estimated value of $25,000 for the purse seine catch associated with an aerial survey calibration study.

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1993-2000.

Year	District	Number of Buyers	Number of Fishermen		
			Gillnet	Seine [a]	Totals
2000	Security Cove	10	79	-	-
	Goodnews Bay	2	57	-	-
	Cape Avinof	1	86	-	-
	Nelson Island	4	86	-	-
	Nunivak Island	1	0	35	-
	Cape Romanzof	2	46	-	-
	Norton Sound	4	91	3	97 [b]
1999	Security Cove	8	87	-	-
	Goodnews Bay	5	94	-	-
	Cape Avinof	3	117	-	-
	Nelson Island	4	94	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	1	57	-	-
	Norton Sound	4	119	0	122 [c]
1998	Security Cove	9	78	-	-
	Goodnews Bay	2	84	-	-
	Cape Avinof	2	109	-	-
	Nelson Island	2	86	-	-
	Nunivak Island	1	7	1	8 [d]
	Cape Romanzof	1	41	-	-
	Norton Sound	2	35	0	47 [e]
1997	Security Cove	14	222	-	-
	Goodnews Bay	3	139	-	-
	Cape Avinof	2	145	-	-
	Nelson Island	3	105	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	3	65	-	-
	Norton Sound	9	214	6	220
1996	Security Cove	14	326	-	-
	Goodnews Bay	5	182	-	-
	Cape Avinof	2	161	-	-
	Nelson Island	3	109	-	-
	Nunivak Island	2	24	-	-
	Cape Romanzof	3	63	-	-
	Norton Sound	10	281	6	287
1995	Security Cove	12	106	-	-
	Goodnews Bay	4	127	-	-
	Cape Avinof	2	93	-	-
	Nelson Island	4	100	-	-
	Nunivak Island	2	13	-	-
	Cape Romanzof	2	49	-	-
	Norton Sound	6	209	6	215
1994	Security Cove	0	0	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	85	-	-
	Nelson Island	3	104	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	2	55	-	-
	Norton Sound	7	212	3	215
1993	Security Cove	1	9	-	-
	Goodnews Bay	3	63	-	-
	Cape Avinof	1	97	-	-
	Nelson Island	1	73	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	2	41	-	-
	Norton Sound	6	256	7	263

a Beach seine gear prohibited in all districts except Norton Sound and Port Clarence. Purse seine gear allowed only in the Nunivak Island District.
b Includes 91 gillnet fishers, 3 beach seiners and 3 kelp fishers.
c Includes 119 gillnet fishers, 1 bait fisher and 2 kelp fishers.
d Includes 7 gillnet fishers and 1 purse seine fisher.
e Includes 35 gillnet fishers, 1 bait fisher and 11 kelp fishers.

Table 4. Pacific herring subsistence harvest (st) and effort data from selected northeastern Bering Sea areas, Alaska, 1978-2000.[a]

Village	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Nelson Island																							
Tunnnak	38	34	65	40	48	94	-	43	63	48	49	47	54	21	32	45	42	30	26	-	-	-	-
Umkumiut	11	8	3	10	0	-	-	-	-	[c]	[c]	[c]	[c]	[c]	[c]	-	-	-	-	-	-	-	-
Toksook Bay	37	51	29	14	35	-	-	46	70	51	58	52	46	40	43	23	53	46	42	-	-	-	-
Nightmute	-	-	-	-	-	-	-	3[b]	21	15	16	15	18	8	10	9	13	13	16	-	-	-	-
Newtok	-	-	-	-	-	-	-	7[b]	13	10	12	10	8	1	7	6	9	9	12	-	-	-	-
Total	86	93	97	64	83	94	-	99	167	124	136	124	126	70	92	82	117	98	95	-	-	-	-
No. Fishing Families	83	54	70	93	65	43	-	65[b]	72[b]	96	104	[b]	100	85	97	89	-	91	96	-	-	-	-
Nunivak Island																							
Mekoryuk	-	-	-	-	-	-	-	<1	<1	-	-	-	5	4	4	2	-	-	-	-	-	-	-
No. Fishing Families	-	-	-	-	-	-	-	11	6[b]	-	-	-	19	20	17	16	-	-	-	-	-	-	-
Other Kuskokwim Delta																							
Chefornak	-	-	-	-	-	-	-	13[b]	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-
Kipnuk	-	-	-	-	-	-	-	9	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-
Kongiganak	-	-	-	-	-	-	-	3	2[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kwigillingok	-	8	13	-	13	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	8	13	-	13	-	-	30	2	28	-	-	-	-	-	-	-	-	-	-	-	-	-
No. Fishing Families	-	22	19	-	21	-	-	55[b]	12[b]	49	-	-	-	-	-	-	-	-	-	-	-	-	-
Yukon Delta																							
Scammon Bay	1	6	3	8	4	3	4	2	2	1	2	1	2	1	1	3	1	1	1	1	<1	6	4
Chevak	-	2	4	2	2	1	3	2	1	1	2	<1	1	<1	<1	<1	2	1	<1	<1	<1	2	1
Hooper Bay	4	3	4	4	5	5	4	4	4	1	4	2	6	2	2	2	3	4	2	2	1	4	1
Total	5	11	11	14	11	9	11	8	6	3	7	3	8	3	4	5	6	6	3	3	2	13	6
No. Fishing Families	30	84	61	45	43	37	47	44	40	23	32	24	32	18	30	42	48	42	29	34	15	67	50

[a] Subsistence survey results are believed to accurately reflect harvest trends however, reported catches reflect minimum figures since all fishermen cannot be contacted.
[b] Fishing families were not interviewed or only a portion of fishing families were interviewed as catch was enumerated while on drying racks.
[c] Umkumiut effort included with Tunnnak.

Table 5. Pacific herring estimated biomass in the northeastern Bering Sea, Alaska, 1978-2000.

	Herring (st)								
Year	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof [a]	Norton Sound	Port Clarence	Total Biomass
1978	1,323	441	-	5,952	805	2,976	5,291	-	16,788
1979	21,495	7,385	-	5,952	-	2,976	7,716	-	45,524
1980	1,213	1,213	-	5,952	-	2,976	8,377	-	19,731
1981	8,267	4,299	-	3,968	19	4,850	22,360	-	44,331
1982	5,071	2,646	-	3,968	-	4,850	19,403	-	33,951
1983	6,393	3,197	-	7,275	7,606	5,512	26,841	-	58,092
1984	5,071	4,079	-	11,023	6,695	6,063	21,475	-	56,079
1985	4,900	4,300	2,000	9,500 [b]	5,700 [b]	7,000	20,000	-	51,400
1986	3,700 [b]	3,000 [b]	-	7,300 [b]	6,000	7,500	28,100	-	55,600
1987	2,300 [b]	2,000 [b]	1,225	8,100	4,400 [b]	7,200	32,370	932	57,332
1988	4,906	4,479	4,108	7,152	2,800 [b]	6,600	33,924	788	64,757
1989	2,830	4,040	2,780 [b]	3,320	620	4,400	25,981	-	43,970
1990	2,650	2,577	2,020 [b]	2,705	422	4,500	39,384	-	54,258
1991	4,434	4,387	2,083	2,385	3,903	4,500	42,854	-	64,546
1992	7,773	5,572	3,446	5,275	5,703	4,500	57,974	1,652	91,895
1993	6,995	6,211	2,837 [b]	4,944	5,176	4,000	46,549	822	77,534
1994	7,638 [b]	5,679 [b]	2,827 [b]	5,564	4,921	5,000	37,829	92	69,550
1995	6,702 [b]	4,219 [b]	3,627 [b]	7,754	4,579 [b]	5,000	37,779	-	69,660
1996	6,867	6,315	4,500 [b]	6,638 [b]	4,195 [b]	6,000	27,307 [b]	-	61,822
1997	4,640 [b]	4,752 [b]	4,600 [b]	7,900 [b]	3,801 [b]	5,000 [c]	47,791	-	78,484
1998	4,017 [b]	4,064 [b]	4,287 [b]	7,136 [b]	3,778 [b]	4,500 [d]	52,033	-	79,815
1999	5,261	6,896	3,555 [b]	6,655	3,319 [b]	3,800 [e]	34,314		63,800
2000	5,237	6,348	3,210	4,672	3,487	3,500 [f]	32,680		59,134

[a] Biomass estimate based on limited aerial survey information, spawn deposition, age composition, and CPUE from commercial and test fisheries.

[b] Unacceptable aerial survey conditions for estimating herring biomass, therefore projected biomass or some other method of estimating biomass was used.

[c] Biomass listed for Cape Romanzof is midpoint for estimated range of 4,500 to 5,500 tons.

[d] Biomass listed for Cape Romanzof is midpoint for estimated range of 4,000 to 5,000 tons.

[e] Biomass listed for Cape Romanzof is midpoint for estimated range of 3,300 to 4,300 tons.

[f] Biomass listed for Cape Romanzof is midpoint for estimated range of 3,000 to 4,000 tons.

Table 6. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 2000.

District	Subdistrict Sec/Area	Gear	Period	Date	Time	Total Hours	Harvest (st)
Security Cove		Gillnet	1	5/13	1630-1830	2.0	32.1
			2	5/18	0900-1100	2.0	169.7
			3	5/18	0900-2300	4.0	94.7
			4	5/19	1000-1300	3.0	2.1
			5	5/19	1900-2400	5.0	0.2
					Total	16.0	298.8
Goodnews Bay		Gillnet	1	5/18	1830-2230	4.0	1.5
			2	5/26	1530-1830	3.0	8.0
			3	5/27	1000-1800	8.0	6.2
			4	5/27-28	2300-0600	7.0	0.8
			5	5/28	1200-1800	6.0	3.9
					Total	28.0	20.3
Cape Avinof		Gillnet	1	6/4	1100-1500	4.0	6.9
			2	6/5	1100-1800	7.0	27.0
			3	6/5-6	2300-0500	6.0	67.0
			4	6/6	1100-1800	7.0	1.6
			5	6/6-7	2300-0600	7.0	1.9
			6	6/7	1200-1900	7.0	90.1
			7	6/8	0000-0700	7.0	26.7
			8	6/8	1300-2000	7.0	98.2
			9	6/9	1530-1830	3.0	42.1
			10	6/10	0530-0830	3.0	15.7
					Total	58.0	377.2
Nelson Island		Gillnet	1	5/28	1800-2200	4.0	25.6
			2	5/29	1700-2300	6.0	184.1
			3	5/30	0800-1200	4.0	170.5
			4	5/30	1800-2400	6.0	426.9
					Total	20.0	807.1
Nunivak Island		Purse Seine	1	5/20-24	2000-1700	93.0	41.3
Cape Romanzof		Gillnet	1	5/29	2200-2330	1.5	30.4
			2	5/31-6/1	2230-0100	2.5	20.1
			3	6/3	0000-0330	3.5	217.8
			4	6/3	1130-1500	3.5	133.0
			5	6/4	0100-0300	2.0	98.2
					Total	13.0	499.5
Norton Sound	1	Gillnet	1	6/7	1100-2100	10.0	310.0
	1, 2, 3		2	6/9	1100-1700	6.0	712.0
	1, 2, 3		3	6/10	1200-2200	10.0	769.5
	1, 2, 3		4	6/11	1100-2400	13.0	863.2
	1, 2, 3		5	6/12-13	1100-0100	14.0	638.3
	1, 2, 3		6	6/13-14	1100-0100	14.0	581.6
	1, 2, 3		7	6/14-15	1100-0100	14.0	486.2
	1, 2, 3		8	6/15	1100-1900	8.0	29.6
			Waste				15.0
						89.0	4,405.3

-continued-

Table 6. (p. 2 of 2)

District	Subdistrict Sec/Area	Gear	Period	Date	Time	Total Hours	Harvest (st)
Norton Sound	2,3	Beach Seine	1	6/7	0600-0900	3.0	0.0
			2	6/8	0700-1000	3.0	49.6
			3	6/9	0500-1000	5.0	31.8
			4	6/9	1400-1800	4.0	0.0
			5	6/10	0700-1000	3.0	0.0
			6	6/10	1800-2200	4.0	0.0
	1		7	6/11	1600-2000	4.0	0.0
						26.0	81.4
	1,2,3,4,5,6	Open Pound	1	5/18-6/20	continuous		2.3 [a]
					Total	115.0	4,486.7 [b]

[a] Product weight

[b] Does not include spawn on kelp product weight.

Table 7. Projections of Pacific herring spawning biomass and harvest guideline for commercial fishing districts in the northeastern Bering Sea, Alaska, 2001.

District	Threshold	Projected [a] Biomass (st)	Exploitation Rate (%)	Harvest (st) [a] Guideline
Security Cove	1,200	4,527	20	905
Goodnews Bay	1,200	5,755	20	1,151
Cape Avinof	500	3,486	15	523
Nelson Island	3,000	3,971	15	594 [b]
Nunivak Island	1,500	3,411	20	682
Cape Romanzof	1,500	2,579 [c]	20	516 [c]
Norton Sound	7,000	26,305	20	5,261
Port Clarence	-	-	-	165 [d]
Totals		50,034		9,798

a Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.

b Nelson Island commercial harvest is 20% of projected biomass minus 200 st for subsistence harvest.

c Projection from midpoint of 2000 biomass estimate of 3,000 to 4,000 tons which was based on spawn deposition, age composition, and CPUE from commercial and test fisheries. Allowable harvest will range from 466 to 566 tons based on inseason indicators of abundance.

d Harvest guideline of 165 st (150 mt).

Table 8. Herring harvest by gear type and subdistrict, Norton Sound District, 1982-2000.

	NORTON SOUND HERRING CATCHES																		
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
GILLNET HARVEST (tons)																			
St. Michael	2,062	434	-	1,538	2,560	2,214	3,215	2,927	4,491	-	-	2,286	249	2,359	3,074	1,575	1,543	285	2,623
Unalakleet	946	1,284	-	95	-	-	42	10	618	731	-	120	12	374	-	20	-	324	
Cape Denbigh	925	2,692	3,244	1,599	2,420	1,545	1,211	1,414	923	4,419	-	1,659	619	1,467	2,507	1,864	1,081	2,138	1,767
Elim	-	65	-	147	-	-	6	-	-	-	-	225	41	1,774	-	-	-	-	-
Golovin	-	85	-	-	-	-	-	-	-	-	-	-	-	191	-	-	-	-	-
Nome																		8	-
Total [a]	3,933	4,540	3,244	3,379	4,980	3,759	4,474	4,351	6,032	5,150	[b]	4,291	921	6,166	5,581	3,459	2,632	2,755	4,390
SEINE HARVEST (tons)																			
St. Michael (beach)	-	-	-	-	-	4	45	329	6	-	-	-	1	-	-	472	-	-	-
Unalakleet (beach)	-	-	-	93	-	-	58	50	332	149	-	467	24	230	111	41	-	-	81
Cape Denbigh (beach)	-	41	327	76	30	293	96	11	9	373	-	222	15	57	325	-	-	-	-
Elim (beach)	-	-	-	-	185	-	-	-	-	-	-	54	-	334	153	-	-	-	-
Cape Denbigh (purse)	-	-	-	-	-	26	-	-	-	-	-	-	-	-	-	-	-	-	-
Total [a]	0	41	327	169	215	323	198	390	347	522	[b]	743	40	621	589	513	0	0	81
TOTAL HARVEST (tons) [a]	3,933	4,581	3,571	3,548	5,195	4,082	4,672	4,741	6,380	5,672	0	5,034	961	6,787	6,170	3,972	2,632	2,755	4,472
Percent of total harvest																			
Gillnet Harvest	100	99.1	90.8	95.2	95.9	92.1	95.8	91.8	94.6	90.8		85.2	95.9	90.9	90.5	87.1	100	100	98.2
Seine Harvest	0	0.9	9.2	4.8	4.1	7.9	4.2	8.2	5.4	9.2		14.8	4.1	9.1	9.5	12.9	0	0	1.8

a Totals do not include waste.
b No commercial fishery.

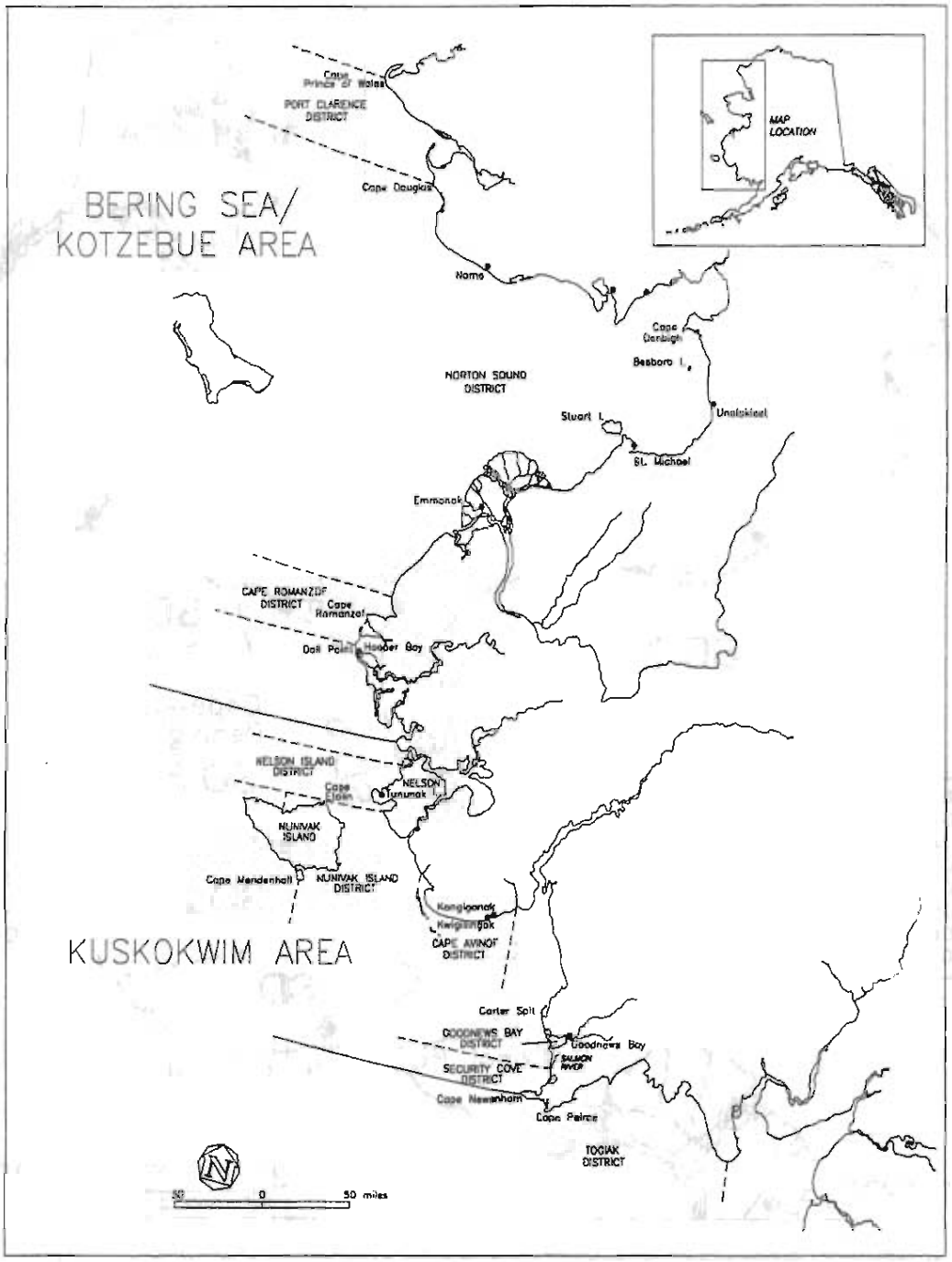

Figure 1. Commercial herring fishing districts within the Arctic-Yukon -Kuskokwim Region of the northeastern Bering Sea, Alaska.

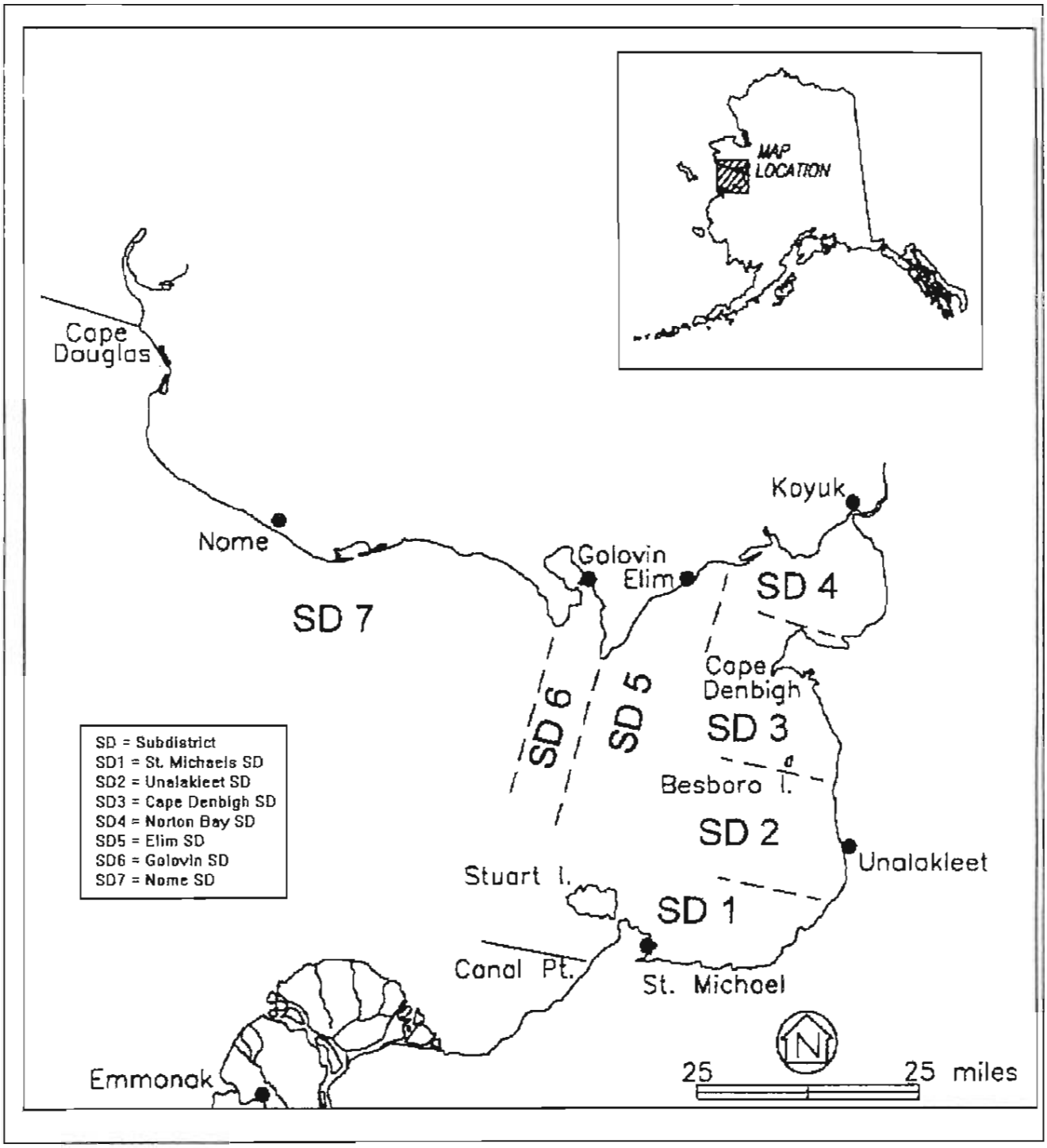

Figure 2. Norton Sound commercial herring subdistricts.

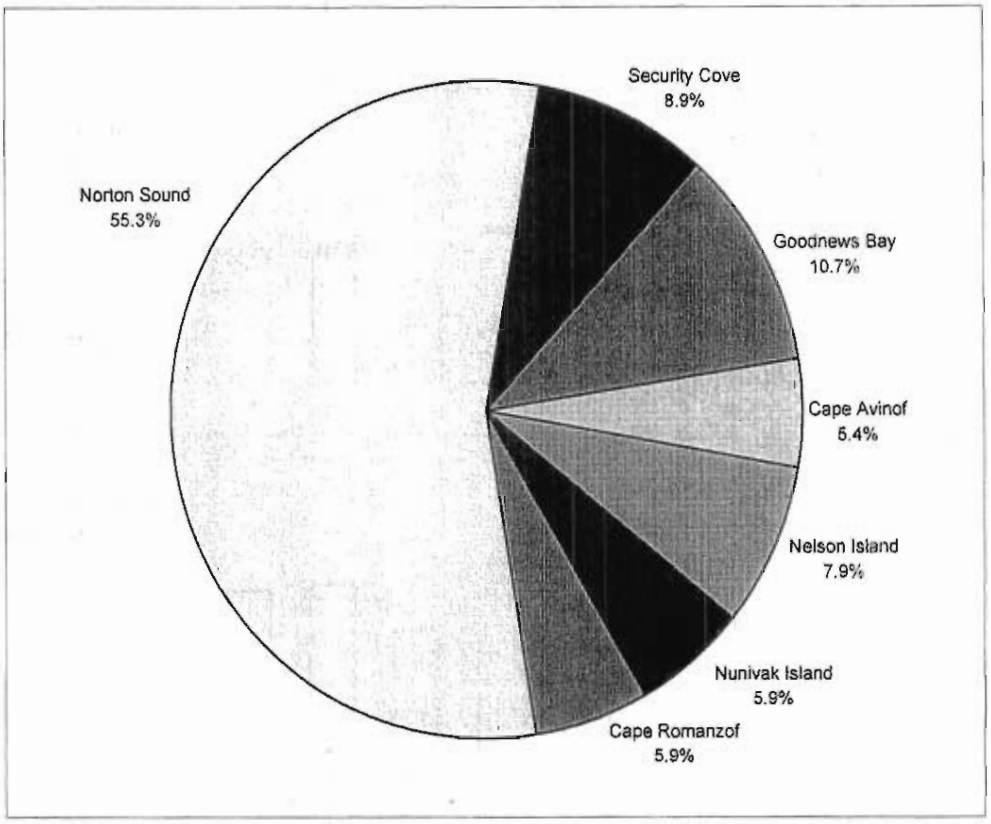

Figure 3. Pacific herring run biomass distribution by commercial fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 2000.

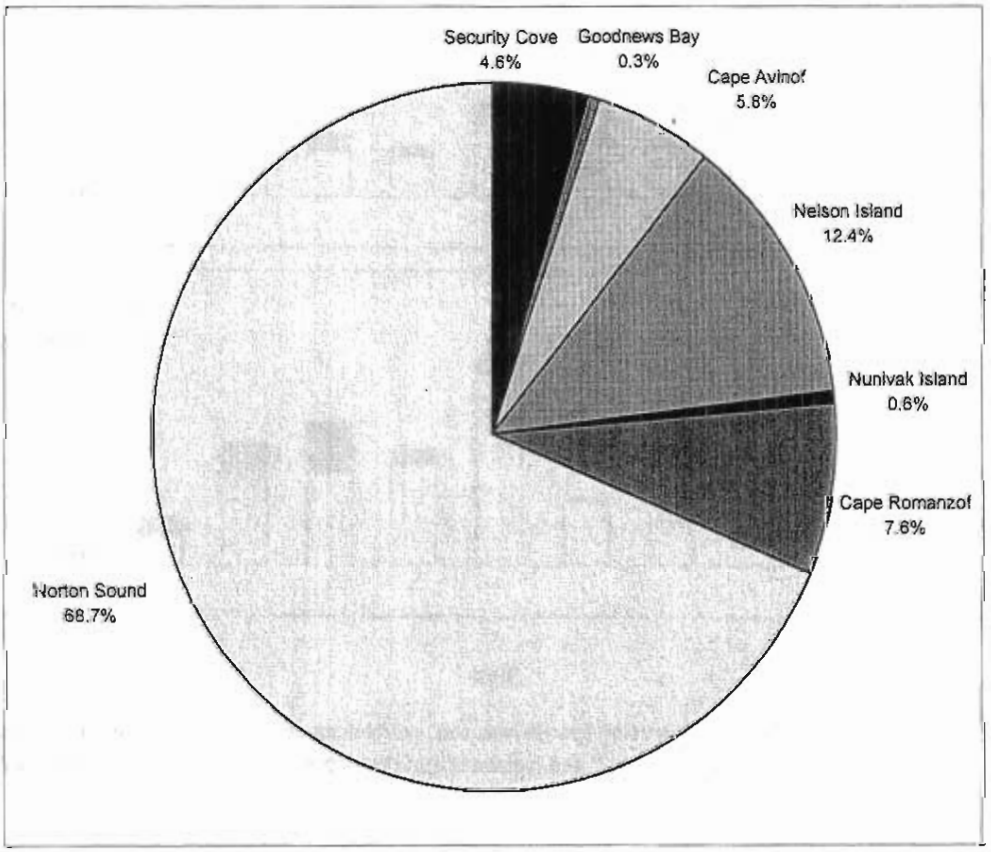

Figure 4. Pacific herring commercial harvest distribution by fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 2000.

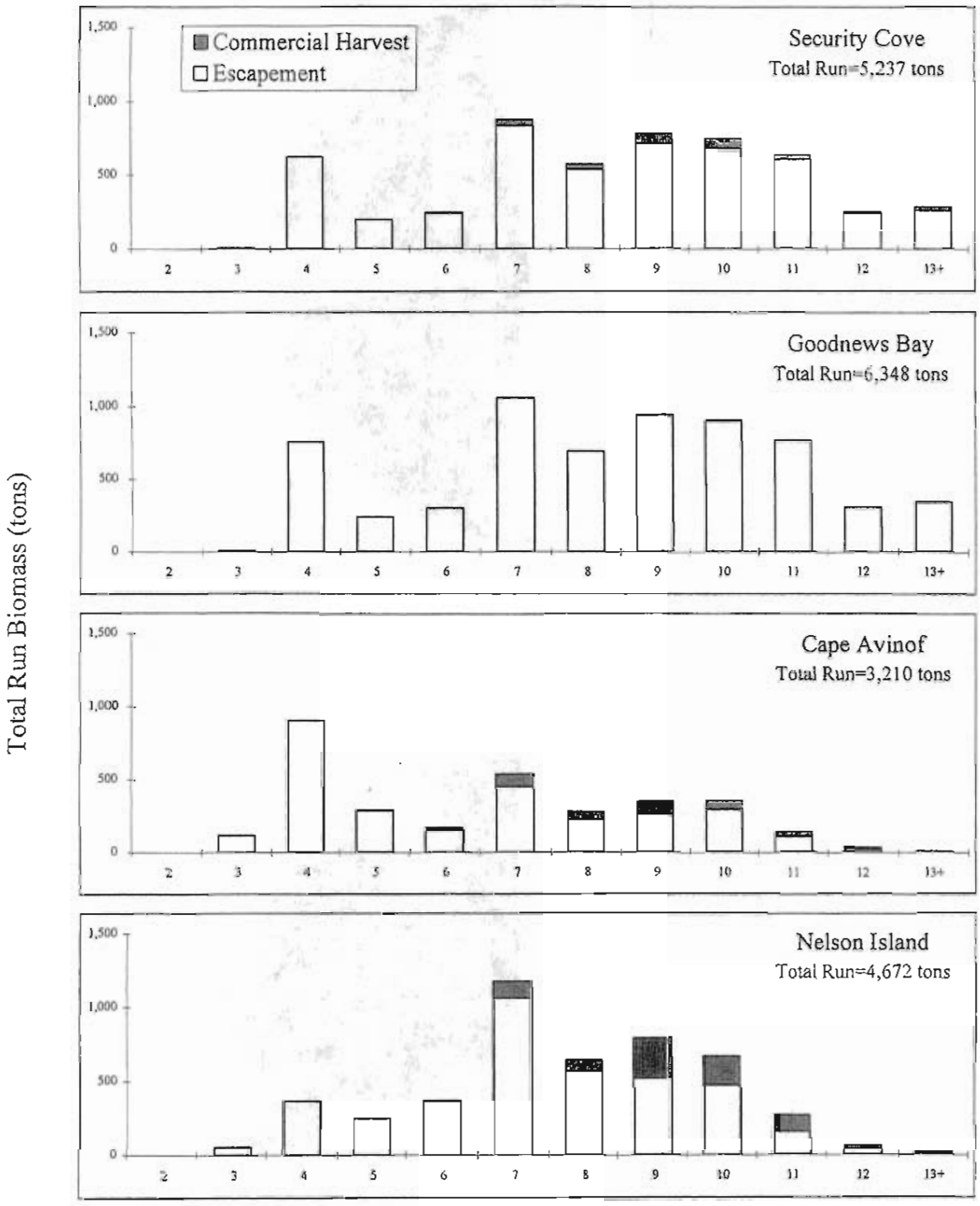

Figure 5. Age composition of Pacific herring for the total run, escapement and harvest biomass for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 2000.

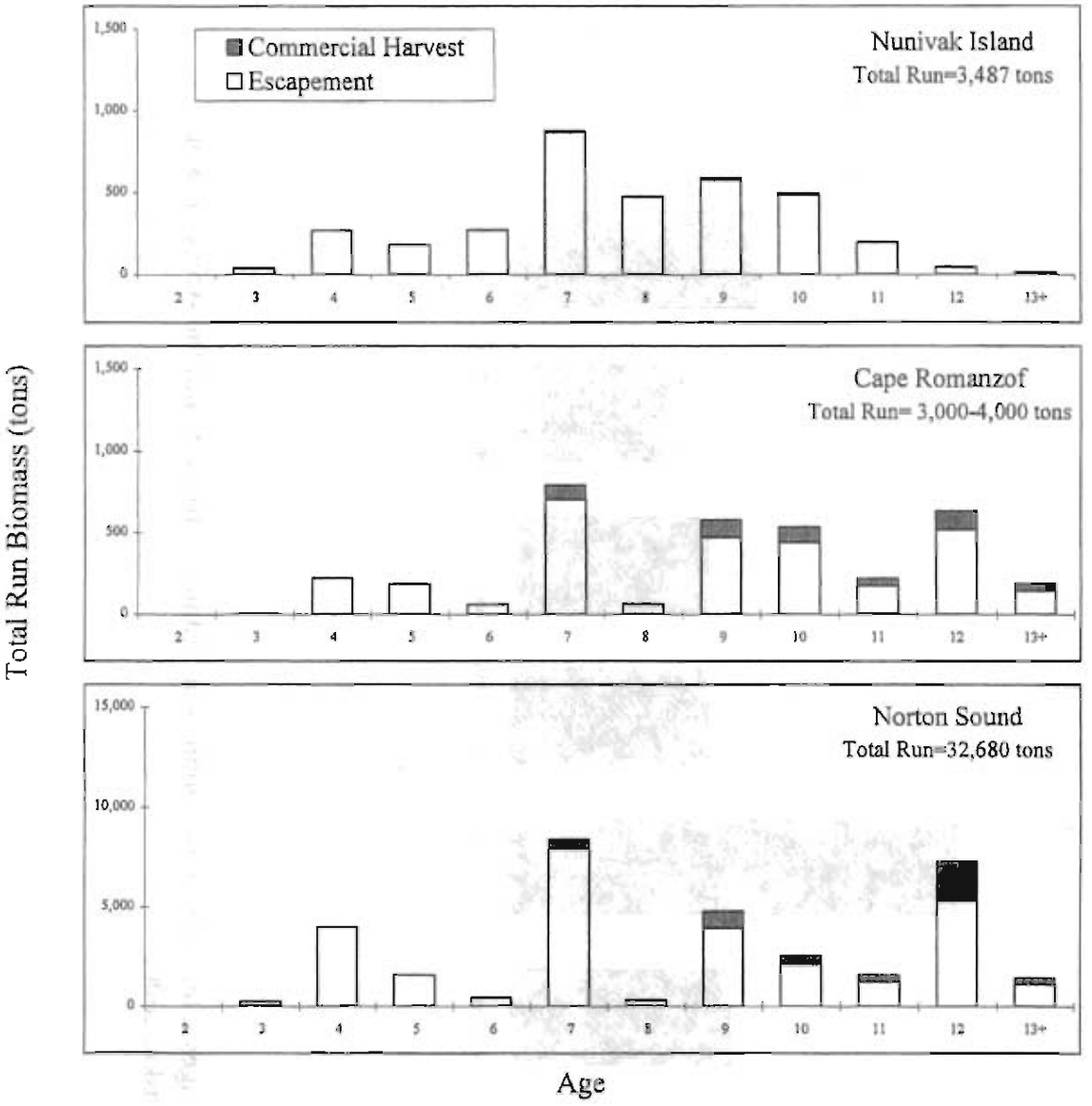

Figure 6. Age composition of Pacific herring for the total run, escapement and harvest biomass for the Nunivak Island, Cape Romanzof, and Norton Sound Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 2000.

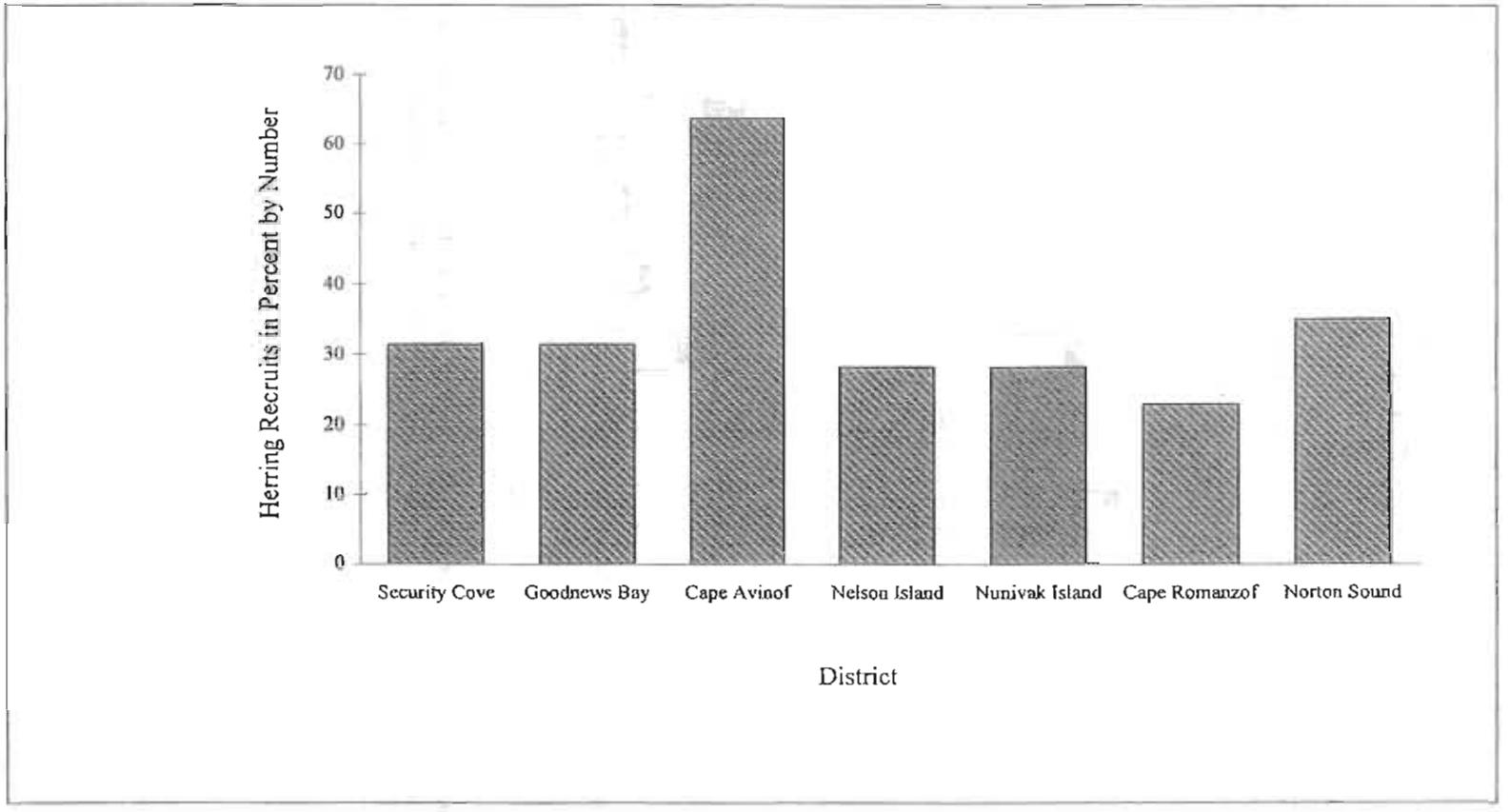

Figure 7. Pacific herring recruits (ages 2 through 5) for commercial fishing districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 2000.